

ADDITIONS TO THE CRUSTACEAN (DECAPODA) FAUNA FROM
THE POTRERILLOS FORMATION (LATE CRETACEOUS) IN
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ABSTRACT

A new species of dorippid crab, *Sodakus mexicanus* n. sp., is described and one species each of callianassid, pagurid, and calappid crustaceans are reported from the Maastrichtian lower siltstone member of the Potrerillos Formation. Chelae remains were identified in order to complete the crustacean inventory of two localities in northeastern Mexico, which have yielded numerous crustacean remains of three other previously reported species of crabs. A paleoenvironmental interpretation of shallow facies within a deltaic system may explain the presence of one of the most diverse crustacean faunas from the Late Cretaceous of Mexico.

INTRODUCTION

Several recent papers have dealt with the paleontology and paleoenvironments of Cretaceous and Tertiary formations from the Difunta Group in northeastern Mexico. Among these, three have focused on the crustacean species from the lower siltstone member of the Potrerillos Formation, Nuevo León state. The first reported a new species of *Costacopluma*, the first record for that genus in America (Vega and Perrilliat, 1989a). Subsequently, Vega and Feldmann (1991) described a new genus and species of carcineretid crab, as well as documenting the presence of *Dakoticancer australis* Rathbun in Mexico for the first time. More recently, the cuticular structure of *Costacopluma mexicana* Vega and Perrilliat was described on the basis of excellently preserved samples of this crab in phosphatic nodules (Vega et al., 1994). The crustacean fauna from the Potrerillos Formation has proven not only to be exceptionally diverse, but also to contain sufficient material to infer paleoenvironmental conditions. For this reason, it is important to complete the faunal list of crustaceans collected at different localities within the La Popa basin in northeastern Mexico. A faunal list of fossils from two major localities in the Potrerillos Formation has recently been published (Vega et al., 1995:347); however, the list does not include a complete list of the crustacean fossils. Table 1 lists all the crustaceans currently known from the unit.

The material reported here was collected at two localities in northwestern Nuevo León and southeastern Coahuila (Fig. 1). Localities have been registered in the Locality Catalogue of the Instituto de Geología, Universidad Nacional Autónoma

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Submitted 1 December 1994.

Table 1.—*Systematic list of decapod crustaceans collected from the Potrerillos Formation. *Taxa reported, or described, in this paper for the first time.*

Infraorder Anomura Milne Edwards, 1832
Family Callianassidae Dana, 1852
? <i>Callianassa</i> sp.*
Family Paguridae Latreille, 1802
<i>Paleopagurus</i> cf. <i>P. pilsbryi</i> Roberts, 1962*
Infraorder Brachyura Latreille, 1803
Family Dakoticancridae Rathbun, 1917
<i>Dakoticancer australis</i> Rathbun, 1935
Family Dorippidae de Haan, 1841
<i>Sodakus mexicanus</i> new species*
Family Calappidae de Haan, 1833
<i>Prehepatus harrisi</i> Bishop, 1985*
Family Carcineretidae Beurlen, 1930
<i>Mascaranada difuntaensis</i> Vega and Feldmann, 1991
Family Retroplumidae Gill, 1894
<i>Costacopluma mexicana</i> Vega and Perrilliat, 1989a

de Mexico (UNAM). Locality A (IGM-2444) has been previously reported (Vega and Feldmann, 1991) as an exposure at the northwest edge of the Delgado syncline, northwest of the town of Mina (Fig. 2). Locality B (IGM-1574) also has been reported previously (Vega and Perrilliat, 1989b; Vega et al., 1994) as an exposure of the syncline known regionally as "Sierra El Antrisco," Mina County, Nuevo León (Fig. 2).

STRATIGRAPHY AND PALEOENVIRONMENT

The Potrerillos Formation includes five members, of which the lower three are Maastrichtian in age (see Vega and Feldmann, 1991:167, for stratigraphic column). Among these three members, the lower siltstone member has proven to be one of the most fossiliferous units within the entire Difunta Group. The lower siltstone member contains numerous index fossils of Maastrichtian age, such as *Exogyra costata* Say, and *Sphenodiscus pleurisepta* (Conrad) (McBride et al., 1974; Wolleben, 1977; Vega and Perrilliat, 1989b). Members of the Potrerillos Formation represent a transgressive phase, with shallow marginal environments at the base of the lower siltstone member. A diverse molluscan fauna has been collected and reported from this member (McBride et al., 1974; Wolleben, 1977; Vega and Perrilliat, 1989b). Locality IGM-1574 has yielded a large number of fossil remains of gastropods, ammonoids, bivalves, and dinosaur bones. A recent paleoenvironmental interpretation for this locality suggests a restricted lagoon with periodic influxes of fresh water (Vega et al., 1994). This kind of paleoenvironment is consistent with the fossil content, which includes numerous crab chelae, as well as phosphatized wood and bones. Frequently, chelae are found in coquinas at the base of the lower siltstone member. These coquinas are interpreted to be storm deposits in this lagoonal environment. As mentioned above, preservation of crustacean remains of samples collected at this locality is frequently excellent. The lithology at locality IGM-2444 is characterized by a light-gray fine sandstone, in which some ostreid banks, about 4 m thick, are developed. These banks are composed mainly of *Exogyra costata*, *Pycnodonte mutabilis* (Morton), and *Arctostrea aguilerae* Böse. The decapod specimen, identified herein as *Prehepatus harrisi* Bishop, was collected near one of these ostreid banks, in the same bed

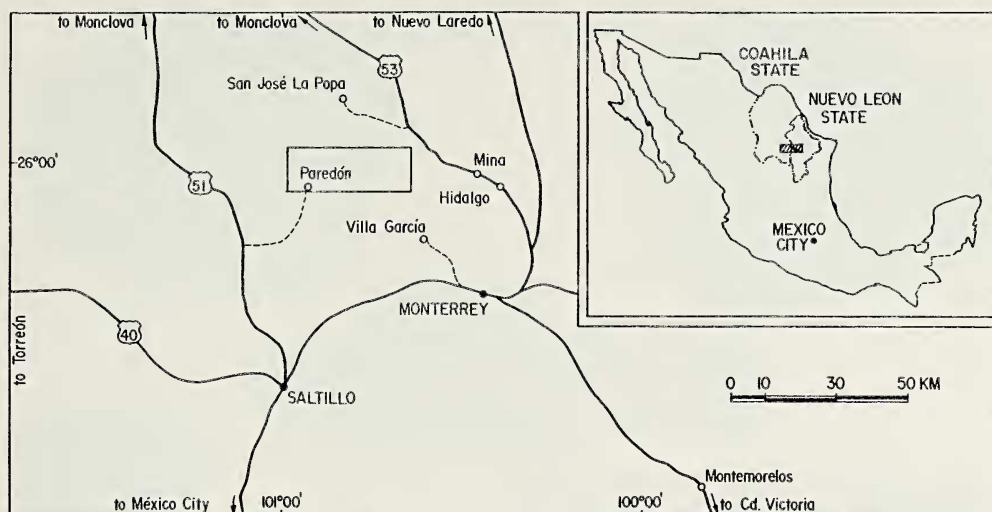


Fig. 1.—General location map of studied area in northeastern Mexico. The framed area is enlarged in Fig. 2.

which contained several specimens of *Dakoticancer australis* Rathbun (Vega and Feldmann, 1991). This kind of association was also documented by Bishop (1985) for samples of *P. harrisi* collected in the Coon Creek and Prairie Bluff formations, Mississippi. Thus, the sediments at locality IGM-2444 are interpreted to have been deposited in nearshore habitats.

Samples reported here are deposited in the collections of the Museo de Paleontología of the Instituto de Geología, UNAM (labeled as “IGM”); and the Section of Invertebrate Paleontology, Carnegie Museum of Natural History (labeled “CM”).

SYSTEMATIC PALEONTOLOGY

Order Decapoda Latreille, 1803

Infraorder Anomura Milne Edwards, 1832

Superfamily Thalassinoidea Latreille, 1831

Family Callianassidae Dana, 1852

Genus *Callianassa* Leach, 1814

?*Callianassa* sp.

(Fig. 3.5, 3.6)

Referred Material.—Three specimens, a crushed but complete major claw (CM 35836), a minor claw (IGM-6776), and an incomplete major claw (CM 35837), comprise the studied material.

Remarks.—A recent reexamination of the American callianassids (Manning and Felder, 1991) has resulted in the recognition of two families, seven subfamilies, and 21 genera. The 16 previously described species had all been assigned to a single family, the Callianassidae. This work detailed the characters useful for recognition of genera, including morphology of the third maxilliped, pleopods, and carapace. Unfortunately, these are features that are only rarely preserved in the fossil record. However, one set of characters, development of hooks or spines

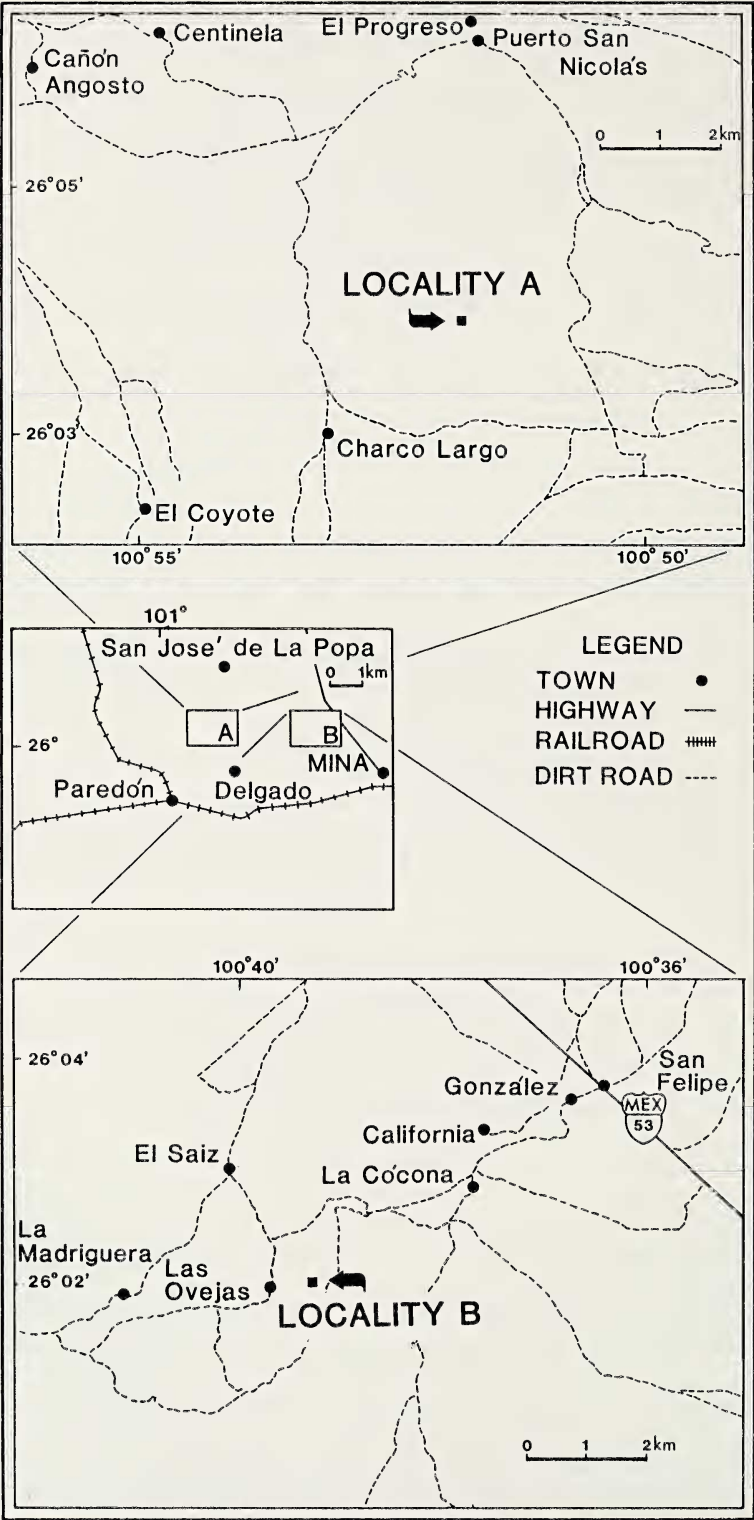




Fig. 3.—*Prehepatus harrisi* Bishop, 1985. 1, 2, outer and inner surface of same sample, IGM-6779. *Paleopagurus* cf. *P. pilsbryi* Roberts, 1962. 3, 4, outer surface of minor cheliped and inner surface of major cheliped, respectively. 3, IGM-6776; 4, CM 35838. ?*Callianassa* sp. 5, inner surface of minor claw, IGM-6775; 6, outer surface of crushed major claw, CM 35836. Scale bar equals 1 cm.

on the merus of the first pereiopods, may be useful in assigning fossil forms to the recognized genera. The overall shape of the propodus and dactylus is not always diagnostic. These are the two elements that most frequently document the occurrence of callianassids in fossil assemblages; the present occurrence is no exception.

The specimens under study consist of three hands with partial fingers. One is relatively small, flattened, elongate, and delicate. The height of the hand is about $\frac{2}{3}$ the length, 21.2 mm. The fingers, which are about $\frac{2}{3}$ as long as the hand, are rounded on the inner surface and keeled on the outer surface. This may represent a minor claw. The other two specimens are badly crushed but each appears to be more robust than the former, with nearly square hands, measuring about 20 mm long in the better preserved specimen, bearing stout fingers that are about as long

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Fig. 2.—Location maps for localities A (IGM-2444) and B (IGM-1574), northwest from Monterrey and south-southeast from the town of San José de La Popa.

as the hand. The fixed finger of these hands is prominently keeled along the outer surface and the keel bears a row of setal pits. These specimens are interpreted to represent major claws. The carpus/propodus articulation on major and minor claws appears to be approximately perpendicular to the long axis of the hand, a feature exhibited on authentic members of *Callianassa*. However, it is not possible to assign these specimens to that genus with certainty because the meral elements are not present. The merus of the major claws on *Callianassa* bears a prominent hook on the proximal corner of the lower surface (Manning and Felder, 1991: 771). In the absence of this element, it is not possible to distinguish *Callianassa* from several other genera, including *Cheramus* Bate, and *Dawsonius* Manning and Felder, among others. Thus, it would seem prudent to adopt the conservative position of questionably referring these specimens from the Difunta Group to ?*Callianassa* until such time as more complete material is discovered or meaningful characters of the hands are recognized.

Superfamily Paguroidea Latreille, 1803
Family Paguridae Latreille, 1802
Genus *Paleopagurus* van Straelen, 1925
Paleopagurus cf. *P. pilsbryi* Roberts, 1962
(Fig. 3.3, 3.4)

Description.—Propodus of minor cheliped 1.8 times longer than height. Carpal articulation perpendicular to lower margin of cheliped and paralleled by distinct, narrow groove. Palm slightly inflated; external surface shows moderately strong and uniformly distributed, randomly arranged granules. Upper margin rounded; length slightly smaller than height of palm (length of upper margin/height ratio = 0.8). Articulation with dactylus forming an obtuse angle with respect to the cutting edge of fixed finger. Fixed finger robust (length/height ratio = 0.5) and short (length/length of propodus ratio = 2.28), with granulose external surface, similar to that of palm; cutting edge bears four truncated teeth with wide bases in proximal half; teeth smaller toward distal end of finger, separated from one another and with subacute apices. Propodus of major cheliped with granulation on internal surface, quite similar to granulation described for external surface of minor cheliped.

Referred Material.—IGM-6776 and CM 35838.

Locality and Stratigraphic Position.—IGM-1574. Base of the lower siltstone member of the Potrillo Formation, lower Maastrichtian.

Measurements.—Minor propodus: length of propodus = 16.2 mm, length of upper margin of palm = 7.2 mm, height of palm = 8.8 mm, length of fixed finger = 7.1 mm, height of fixed finger = 3.7 mm.

Remarks.—*Paleopagurus pilsbryi* has been described from the Merchantville Formation of New Jersey and Delaware (Roberts, 1962). Specimens from Nuevo León closely resemble this species. However, authentic specimens of *P. pilsbryi* seem to be smaller than the Difunta specimens. Additionally, teeth are absent on the cutting edge of the fixed finger in the species from New Jersey. However, there is close similarity in ornamentation of both inner and outer surfaces of the propodus between our samples and those described by Roberts. For this reason, the material can be assigned to *P. cf. P. pilsbryi* until such time as more complete samples are discovered to assure the systematic position of the pagurids from Nuevo León.

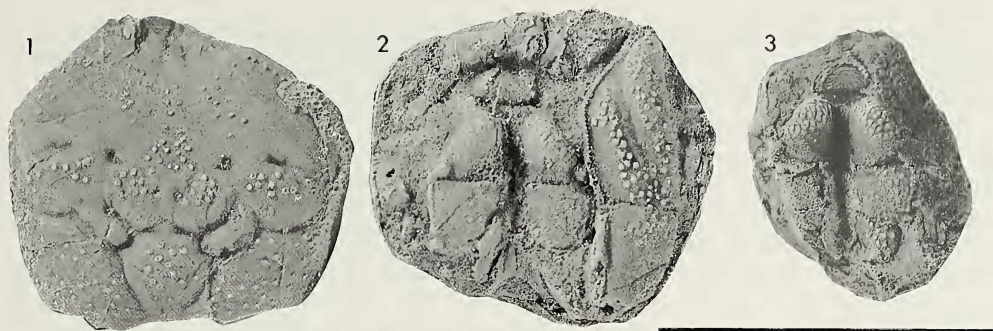


Fig. 4.—*Sodakus mexicanus* n. sp. 1, 2, dorsal and ventral sides of holotype, IGM-6777; 3, ventral side of paratype, CM 35839. Scale bar equals 1 cm.

Infraorder Brachyura Latreille, 1803
 Section Heterotremata Guinot, 1977
 Superfamily Dorippoidea MacLeay, 1838
 Family Dorippidae MacLeay, 1838
 Genus *Sodakus* Bishop, 1978
Sodakus mexicanus **new species**
 (Fig. 4.1–4.3)

Type Specimens.—Holotype: IGM-6777; three paratypes: IGM-6778, CM 35839, and CM 35840.

Diagnosis.—Small *Sodakus* with ovoid outline and incompletely developed cervical groove.

Description.—Small crab for genus; rounded outline, may be slightly wider than long; gently arched longitudinally; transverse cross section gently arched axially becoming steeper near margin; regions moderately well defined as weakly swollen areas separated by narrow grooves.

Frontal and orbital margins incompletely preserved. Front appears to be narrow, axially depressed, with a weak axial elevation extending posteriorly into mesogastric region, defined by lateral sulci. Orbital regions apparently short, directed anterolaterally. Anterolateral margins smoothly convex, terminating posteriorly as radius of curvature decreases. Lateral margins gently arcuate, convergent posteriorly. Posterior margin and posterior portion of carapace not preserved.

Carapace regions well defined in posterior half of carapace, subtle in anterior area. Mesogastric region widening posteriorly, defined by shallow, arcuate, concave outward grooves; surface of region with tiny pustules becoming stronger posteriorly. Protogastric region with pustulose surface, otherwise undifferentiated. Hepatic region smooth except for single line of pustules defining anterolateral margin. Cervical groove defined only by circular pits at corners of metagastric region and transversely elongate pits situated at midpoint between circular pits and lateral margins. Urogastric regions developed as narrow constriction between ovoid, inflated, pustulose, branchial lobes. Posterior gastric pits prominent. Cardiac region more or less pentagonal, well defined; surface with moderately coarse pustules. Epibranchial region transversely ovoid, with pustules arrayed in transverse line. Mesobranchial region a small, smooth, reniform extension of epibranchial area directed toward anterolateral corners of cardiac region. Metabranchial region weakly inflated, with uniformly distributed pustules over entire surface.

Pterygostomial region with two longitudinal pustulose ridges converging posteriorly and separated by distinct smooth sulcus, inner border finely beaded. Buccal cavity widens anteriorly.

Sternum elongate oval. Somites 1–3 fused into triangular plate with smooth, depressed surface and raised, beaded margin. Somite 4 generally triangular, widens posteriorly, strongly swollen into bosses on either side of narrowly depressed axial region on males. Somite 5 nearly quadrate, almost as long as somite 4, narrowing slightly toward posterior. Somite 6 smaller, narrower, generally triangular. Somite seven poorly exposed, small, rotated upward from the plane of other abdominal somites.

Remainder of sternum, abdomen, and appendages not known.

Measurements.—Because the margins of the specimens are broken, no complete measurements can be taken. The dimensions of the holotype specimen are: length, >9.5 mm; width, >10.3 mm.

Locality and Stratigraphic Position.—IGM-1574: base of the lower siltstone member of the Potrerillos Formation, lower Maastrichtian.

Etymology.—The name of the species refers to the occurrence of this species in Mexico.

Remarks.—Assignment of these specimens to *Sodakus* documents only the second species known from a taxon first recognized in the Upper Cretaceous Pierre Shale in South Dakota (Bishop, 1978). This new species exhibits a strongly developed transverse groove, interpreted to be the branchiocardiac groove, and a reduced cervical groove, represented by a pair of pits on either side of the mesogastric region. These features are similar to those seen on *Sodakus tatan-kayotankaensis* Bishop. The type species also has two transverse grooves; however, the cervical groove is more completely developed in the type than it is in the new species. In addition, the sterna of the two species are very similar in general proportions and conformation. Somites 1–3 are fused into a triangular plate which is bordered by a granular rim. This plate, in turn, seems to be fused to somite 4, forming a larger, triangular unit. The only major point of differentiation between the two species is the general outline of the carapace. *Sodakus mexicanus* would appear to have an ovoid outline whereas that of *S. tatan-kayotankaensis* is elongate. Because all the specimens of *S. mexicanus* are broken along the posterior margin, it is not possible to describe the outline with certainty and, in fact, the posterior region may be more drawn out. It is not possible to make a detailed comparison of the ornamentation on the two species. The pattern of granulation on *Sodakus mexicanus* would be distinctive; however, the cuticle on specimens of *S. tatan-kayotankaensis* is poorly preserved. If granular, it would appear to be much more finely so than on the new species.

Within the Dorippidae, one other genus, *Falconoplax* Van Straelen, containing a single species, *F. kugleri* Van Straelen (1933) from the upper Eocene of Venezuela, is defined based on characters that are comparable to those exhibited in the new species. *Falconoplax kugleri* is ovoid in outline and has a cervical groove which is reduced to a pair of pits. However, the posterolateral margins are divergent posteriorly on this species. Further comparison is difficult because, despite the large number of specimens of the species, approximately 200, their preservation is poor and more detailed comparison is difficult. This similarity in general features may suggest that *Sodakus* and *Falconoplax* are closely related and that the latter may have been derived from *Sodakus*.

Superfamily Calappoidea de Haan, 1833
Family Calappidae de Haan, 1833
Genus *Prehepatus* Rathbun, 1935
Prehepatus harrisi Bishop, 1985
(Fig. 3.1, 3.2)

Prehepatus harrisi Bishop, 1985:1029–1031, fig. 1.1–1.5, 2.1–2.9. Bishop, 1986:120, fig. 7C.

Description.—Rectangular shape for palm, whose appendix is directed toward carpal articulation, which is robust (width/medial length ratio = 0.5), slightly longer than high (medial length/maximum height ratio = 0.8), with strongly marked tubercles in both internal and external surfaces, with a moderately deep transverse groove, delimiting articulation with dactylus. External and internal surfaces entirely covered by areolations. External surface convex, with four arched longitudinal rows of five to six tubercles each; tubercles randomly distributed on upper third. Upper margin rounded, with row of five strong tubercles; lower margin broadly rounded, with smaller, randomly distributed tubercles. Inner surface with fewer and finer tubercles than external surface, concentrated toward central portion of palm; inner surface smooth toward carpal and dactylar articulations; upper margin of inner surface with five tubercles as strong as, but sharper than, those of the external surface.

Small proximal portion of movable finger is preserved. It is strong, occupying almost half of distal margin of palm. Height of movable finger measured at base/maximum height of palm ratio = 0.4. Strong tubercles on upper margin of palm continue toward dorsal portion of movable finger.

Referred Material.—IGM-6779.

Locality and Stratigraphic Position.—Lower siltstone member of Potrerillos Formation, lower Maastrichtian.

Measurements.—Palm length along medial line = 30.5 mm, superior margin length = 24.0 mm, maximum distal height = 27.4 mm, maximum proximal height = 18.2 mm, width = 15.1 mm, height of movable finger = 11.0 mm.

Remarks.—The specimen from the Potrerillos Formation is represented only by a piece of a major chela, the right manus, which lacks both movable and fixed fingers. However, the preservation of the palm and its ornamentation is sufficient to assign the specimen to *Prehepatus*.

Bishop (1985:1028) listed all species of *Prehepatus* that had been described at that time. Among these, the only Maastrichtian species is *P. harrisi* from the Coon Creek and Prairie Bluff formations, Mississippi. Features of the specimen from the Potrerillos Formation closely fit the description for this species. Bishop (1985) stated that *P. harrisi* was the largest species within the genus. Comparatively, the sample from Nuevo León is the largest chela reported for the genus. Although the propodus from Nuevo León has a rather rectangular shape, it exhibits five arched rows of five to six granulated tubercles on the outer surface, typical for *P. harrisi*. The propodus of *P. cretaceous* Rathbun from the Albian of Texas also has a rectangular shape, but it differs from our material in having only two rows of apparently smooth tubercles, numbering four in each row, on the outer face.

ACKNOWLEDGMENTS

Three anonymous reviewers provided useful comments on the manuscript. Contribution 569, Department of Geology, Kent State University, Kent, Ohio 44242.

LITERATURE CITED

- BEURLIN, K. 1930. Vergleichende Stammesgeschichte Grundlagen, Methoden, Probleme unter Besonderer Berücksichtigung der höheren Krebstiere. *Fortschrift Geologie und Palaeontologie*, 8:317–586.
- BISHOP, G. A. 1978. Two new crabs, *Sodakus tatankayotankaensis* n. gen., n. sp. and *Raninella oaheensis* n. sp. (Crustacea, Decapoda), from the Upper Cretaceous Pierre Shale of South Dakota. *Journal of Paleontology*, 52:608–617.
- . 1985. A new crab, *Prehepatus harrisi* (Crustacea, Decapoda) from the Coon Creek and Prairie Bluff formations, Union County, Mississippi. *Journal of Paleontology*, 59:1028–1032.
- . 1986. Occurrence, preservation, and biogeography of the Cretaceous crabs of North America. Pp. 111–142, in *Crustacean Biogeography, Crustacean Issues* (R. H. Gore and K. L. Heck, eds.), A. A. Balkema, Rotterdam, 292 pp.
- DANA, J. D. 1852. Crustacea. United States Exploring Expedition during the Years 1838, 1839, 1840, 1841, 1842 Under the Command of Charles Wilkes, U.S.N., 13, C. Sherman, Philadelphia, 1620 pp.
- DE HAAN, W. 1833–1850. Crustacea. Pp. 1–243, pls. A–Q, 1–55, in *Fauna Japonica sive descriptio animalium, quae in itinere per Japoniam, jussu et auspiciis superiorum, qui summum in India Batava Imperium tenent, suscepto, annis 1823–1830 collegit, notis, observationibus et adumbrationibus illustravit* (P. F. von Siebold, ed.), A. Arnz, Lugdunum Batavorum, 910 pp.
- GILL, T. 1894. A new bassalian type of crab. *The American Naturalist*, 28:1043–1045.
- GUINOT, D. 1977. Propositions pour une nouvelle classification des Crustacés Décapodes Brachyours. *Compte Rendu Hebdomadaire des Séances de l'Académie des Sciences, Paris, série D*, 285:1049–1052.
- LATREILLE, P. A. 1802–1803. *Histoire naturelle, général et particulière, des crustacés et des insectes: Volume 3*. F. Dufart, Paris, 468 pp.
- . 1831. *Cours d'Entomologie, ou de l'histoire naturelle des Crustacés, des Arachnides, des Myriapodes et des Insectes, etc.* Annales I. Atlas, Roret, Paris, 26 pp.
- LEACH, W. E. 1814. Crustaceology. *Edinburgh Encyclopaedia*, 7:383–437.
- MACLEAY, W. S. 1838. On the brachyurous decapod Crustacea brought from the Cape by Dr. Smith. Pp. 53–71, plates 2, 3, in *Illustrations of the Annulosa of South Africa; Being a Portion of the Objects of Natural History Chiefly Collected during an Expedition into the Interior of South Africa, Under the Direction of Dr. Andrew Smith, in the Years 1834, 1835, and 1836; Fitted Out by "The Cape of Good Hope Association for Exploring Central Africa"* (A. Smith, ed.), Smith, Elder & Company, London, 278 pp.
- MANNING, R. B., AND D. L. FELDER. 1991. Revision of the American Callinassidae (Crustacea: Decapoda: Thalassinidea). *Proceedings of the Biological Society of Washington*, 104:764–792.
- MCBRIDE, E. F., A. E. WEIDIE, J. A. WOLLEBEN, AND R. C. LAUDON. 1974. Stratigraphy and structure of the Parras and La Popa basins, northeastern Mexico. *Geological Society of America Bulletin*, 84:1603–1622.
- MILNE EDWARDS, H. 1832. Observations sur les Crustacés du genre *Mithrax*. *Magasin de Zoologie*, 2, class 7, pl. 1–5.
- RATHBUN, M. J. 1917. New species of South Dakota Cretaceous crabs. *U.S. National Museum Proceedings*, 52:385–391.
- . 1935. Fossil Crustacea of the Atlantic and Gulf Coast Plain. *Geological Society of America Special Paper* 2, 160 pp.
- ROBERTS, H. B. 1962. The Upper Cretaceous decapod crustaceans of New Jersey and Delaware. Pp. 163–191, in *The Cretaceous Fossils of New Jersey* (H. G. Richards, ed.), New Jersey Bureau of Geology and Topography, Bulletin 61, 237 pp., 94 pls.
- VAN STRAELEN, V. 1925. Contribution à l'étude des crustacés décapodes de la période jurassique. *Académie Royale Belgique, Classe des Sciences, Mémoire, séries 2*, 7:1–462.
- . 1933. Sur des crustacés décapodes Cénozoïques du Venezuela. *Bulletin du Musée royal d'Histoire naturelle de Belgique*, 9:1–13.
- VEGA, F. J., AND R. M. FELDMANN. 1991. Fossil crabs (Crustacea, Decapoda) from the Maastrichtian Difunta Group, northeastern Mexico. *Annals of Carnegie Museum*, 60:163–177.
- VEGA, F. J., AND M. C. PERRILLAT. 1989a. Una especie nueva de cangrejo del género *Costacopluma* (Crustacea: Decapoda: Retroplumidae) del Maastrichtiano de Nuevo León, México. *México, Universidad Nacional Autónoma, Instituto de Geología, Revista*, 8:84–87.
- . 1989b. Moluscos del Maastrichtiano de la Sierra El Antrisco, Nuevo León, México. *México, Universidad Nacional Autónoma, Instituto de Geología, Paleontología Mexicana*, 55:1–54.

- VEGA, F. J., R. M. FELDMANN, AND V. DAVILA ALCOCER. 1994. Cuticular structure in *Costacophuma mexicana* Vega and Perrilliat, from the Difunta Group (Maastrichtian) of northeastern Mexico, and its paleoenvironmental implications. *Journal of Paleontology*, 68:1074–1081.
- VEGA, F. J., R. M. FELDMANN, AND F. SOUR-TOVAR. 1995. Fossil crabs (Crustacea: Decapoda) from the Late Cretaceous Cárdenas Formation, east-central Mexico. *Journal of Paleontology*, 69:340–350.
- WOLLEBEN, J. A. 1977. Paleontology of Difunta Group (Upper Cretaceous–Tertiary) in northern Mexico. *Journal of Paleontology*, 51:373–398.